

CLAIMS

What is claimed is:

1. A fire retardant polymer composition comprising:
 - a polymer material;
 - a plurality of monomers of a polycondensed partially hydrolyzed chelated metal oxide precursor; and
 - at least one flame retardant constituent.
2. The fire retardant polymer composition of claim 1, wherein said polymer material comprises at least one of an acrylic, an unsaturated polyester, a saturated polyester, an alkyd, a vinyl ester, a polyurethane, an epoxy, a phenol, an urea-aldehyde, a polyvinyl aromatic, a maleimide, a polyvinyl halide, a polyolefin, a polyorganosiloxane, an amino resin, a polyamide, a polyimide, a polyetherimide, a polyphenylene sulfide, an aromatic polysulfone, a polyamideimide, a polyesterimide, a polyesteramideimide, a polyvinyl acetal, a fluorinated polymer, and a polycarbonate.
3. The fire retardant polymer composition of claim 1, wherein said polycondensed partially hydrolyzed chelated metal oxide precursor comprises at least one of a transition metal, an alkaline earth metal and a metallic element from Groups 3A, 4A and 5A of the periodic table of elements.
4. The fire retardant polymer composition of claim 1, wherein said polycondensed partially hydrolyzed chelated metal oxide precursor comprises at least one of aluminum, antimony, bismuth, calcium, chromium, magnesium, tin, titanium, zinc, and zirconium.
5. The fire retardant polymer composition of claim 1, wherein the polycondensed partially hydrolyzed chelated metal oxide precursor comprises a multifunctional compound containing at least one chelating group coordinated to at least one of an alkaline earth metal, a transition metal, a Group 3A metal, a Group 4A metal and a Group 5A metal.

6. The fire retardant polymer composition of claim 1, wherein the polycondensed partially hydrolyzed chelated metal oxide precursor comprises a multifunctional compound selected from the group comprising alkoxylated diamines, aminoalkylphosphonic acid, amino tris(methylene phosphonic acid), citric acid, diethylenetriamine pentaacetic acid, ethylenediaminetetraacetic acid, gluconic acid, glucoheptonic acid, hexamethylenediamine tetra(methylene phosphonic acid), 2-(methacryloyloxy)ethyl acetoacetate, 5-(methacryloyloxy)methyl salicylic acid, 4-methacryloylamino salicylic acid, hydroxyethyl salicylate, hydroxyethyl salicylamide, 2-(2-hydroxy ethoxy) phenol, o-hydroxybenzoylacetone, 5-hydroxy-2-(hydroxymethyl)-4H-pyran-4-one, N-hydroxyethylenediaminetriacetic acid, hydroxyethylidene diphosphonic acid, hydroxyethane diphosphonic acid, nitrilotriacetic acid, sorbitol, tolyltrizole, o-hydroxybenzoylacetone, 2-hydroxydibenzoylmethane, N-(acetoacetyl)glycine, acetylacetone, poly(ethylene glycol) methacrylate, and poly(propylene glycol) methacrylate.

7. The fire retardant polymer composition of claim 1, wherein the polycondensed partially hydrolyzed chelated metal oxide precursor comprises a supplemental multifunctional compound selected from the group comprising acetylacetone, poly(ethylene glycol) methacrylate, poly(propylene glycol) methacrylate, salicylic acid, 3-hydroxy-2-methyl-4-pyrone, and 8-hydroxyquinolone.

8. The fire retardant polymer composition of claim 1, wherein said at least one flame retardant constituent comprises at least one of a halogen-based, a phosphorous-based, a nitrogen-based and a sulfur-based flame retardant constituent.

9. The fire retardant polymer composition of claim 1, further comprising at least one of a blowing agent, a fibrous reinforcing material, a pigment, a mold release agent, a thermoplastic polymeric material, an elastomeric polymeric material, a shrink control agent, a wetting agent, an antifoam agent, a surface treatment agent, a surface treatment agent, and a thickener.

10. The fire retardant polymer composition of claim 1, wherein said fire retardant polymer composition is transparent.

11. A process for making a flame retardant polymer composition comprising the steps of:
- contacting a polymer material with a metal oxide sol comprising a liquid and a condensation product of a partially hydrolyzed chelated metal oxide precursor to form a mixture;
- contacting said polymer material with at least one flame retardant constituent; and
- at least one of polymerizing and solidifying said polymer material.
12. The process of claim 11, the process further comprising the step of selecting said polymer material from the group comprising an acrylic, an unsaturated polyester, a saturated polyester, an alkyd, a vinyl ester, a polyurethane, an epoxy, a phenol, an urea-aldehyde, a polyvinyl aromatic, a maleimide, a polyvinyl halide, a polyolefin, a polyorganosiloxane, an amino resin, a polyamide, a polyimide, a polyetherimide, a polyphenylene sulfide, an aromatic polysulfone, a polyamideimide, a polyesterimide, a polyesteramideimide, a polyvinyl acetal, a fluorinated polymer, and a polycarbonate.
13. The process of claim 11, the process further comprising the step of formulating said metal oxide sol by contacting a metal oxide precursor with a multifunctional compound.
14. The process of claim 13, the process further comprising the step of selecting said metal oxide precursor from the group comprising at least one of a transition metal, an alkaline earth metal and a metallic element from Groups 3A, 4A and 5A of the periodic table of elements.
15. The process of claim 13, the process further comprising the step of selecting said multifunctional compound from the group comprising alkoxylated diamines, aminoalkylphosphonic acid, amino tris(methylene phosphonic acid), citric acid, diethylenetriamine pentaacetic acid, ethylenediaminetetraacetic acid, gluconic acid, glucoheptonic acid, hexamethylenediamine tetra(methylene phosphonic acid), 2-(methacryloyloxy)ethyl acetoacetate, 5-(methacryloyloxy)methyl salicylic acid, 4-methacryloylamino salicylic acid, hydroxyethyl salicylate, hydroxyethyl salicylamide, 2-(2-hydroxy ethoxy) phenol, o-hydroxybenzoylacetone, 5-hydroxy-2-(hydroxymethyl)-4H-pyran-4-one, N-hydroxyethylenediaminetriacetic acid, hydroxyethylidene diphosphonic acid, hydroxyethane diphosphonic acid, nitrilotriacetic acid, sorbitol, tolyltrizole, o-

hydroxybenzoylacetone, 2-hydroxydibensoylmethane, N-(acetoacetyl)glycine, acetylacetone, poly(ethylene glycol) methacrylate, and poly(propylene glycol) methacrylate.

16. The process of claim 13, the process further comprising the step of formulating said metal oxide sol by contacting said metal oxide precursor with a supplemental multifunctional compound, said supplemental multifunctional compound selected from the group comprising acetylacetone, poly(ethylene glycol) methacrylate, poly(propylene glycol) methacrylate, salicylic acid, 3-hydroxy-2-methyl-4-pyrone, and 8-hydroxyquinolone.

17. The process of claim 11, the process further comprising the step of removing said liquid from said mixture prior to the step of at least one of polymerizing and solidifying said polymer material.

18. The process of claim 11, the process further comprising the step of removing said liquid from said mixture after the step of at least one of polymerizing and solidifying said polymer material.

19. The process of claim 11, wherein said step of combining said mixture with at least one flame retardant constituent comprises selecting said at least one flame retardant constituent from the group comprising a halogen-based, a phosphorous-based, a nitrogen-based and a sulfur-based flame retardant constituent.

20. The process of claim 11, the process further comprising the step of contacting said mixture with at least one ingredient selected from the group comprising a blowing agent, a fibrous reinforcing material, a pigment, a mold release agent, a thermoplastic polymeric material, an elastomeric polymeric material, a shrink control agent, a wetting agent, an antifoam agent, a surface treatment agent, and a thickener.

21. The process of claim 11, wherein said step of contacting said polymer material with at least one flame retardant constituent is performed after said step of contacting said polymer material with a metal oxide sol.

22. A fire retardant polymer foam composition comprising:

a polymer material;

a plurality of monomers of a polycondensed partially hydrolyzed chelated metal oxide precursor;

a flame retardant constituent; and

a blowing agent.

23. The fire retardant polymer foam composition of claim 22, wherein said polymer material comprises polyurethane.

24. The fire retardant polymer foam composition of claim 22, wherein said partially hydrolyzed chelated metal oxide precursor comprises at least one of a transition metal, an alkaline earth metal and a metallic element from Groups 3A, 4A and 5A of the periodic table of elements.

25. The fire retardant polymer foam composition of claim 24, wherein said partially hydrolyzed chelated metal oxide precursor comprises at least one of aluminum, antimony, bismuth, calcium, chromium, magnesium, tin, titanium, zinc and zirconium.

26. The fire retardant polymer foam composition of claim 22, wherein the partially hydrolyzed chelated metal oxide precursor comprises a multifunctional compound containing at least one chelating group coordinated to at least one of an alkaline earth metal, a transition metal, a Group 3A metal, a Group 4A metal and a Group 5A metal.

27. The fire retardant polymer foam composition of claim 22, wherein the partially hydrolyzed chelated metal oxide precursor comprises a multifunctional compound selected from the group comprising alkoxylated diamines, aminoalkylphosphonic acid, amino tris(methylene phosphonic acid), citric acid, diethylenetriamine pentaacetic acid, ethylenediaminetetraacetic acid, gluconic acid, glucoheptonoic acid, hexamethylenediamine tetra(methylene phosphonic acid), 2-(methacryloyloxy)ethyl acetoacetate, 5-(methacryloyloxy)methyl salicylic acid, 4-methacryloylamino salicylic acid, hydroxyethyl salicylate, hydroxyethyl salicylamide, 2-(2-hydroxy ethoxy) phenol, o-hydroxybenzoylacetone, 5-hydroxy-2-(hydroxymethyl)-4H-pyran-4-one, N-

hydroxyethylenediaminetriacetic acid, hydroxyethylidene diphosphonic acid, hydroxyethane diphosphonic acid, nitrilotriacetic acid, sorbitol, tolyltrizole, o-hydroxybenzoylacetone, 2-hydroxydibenzoylmethane, N-(acetoacetyl)glycine, acetylacetone, poly(ethylene glycol) methacrylate, and poly(propylene glycol) methacrylate.

28. The fire retardant polymer foam composition of claim 22, wherein said at least one flame retardant constituent comprises at least one of a halogen-based, a phosphorous-based, a nitrogen-based and a sulfur-based flame retardant constituent.